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A mixed frequency approach to the forecasting of private consumption with ATM/POS data

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ABSTRACT

The recent worldwide development and widespread use of electronic payment systems has provided an opportunity to explore new sources of data for the monitoring of macroeconomic activity. In this paper, we analyse the usefulness of data collected from automated teller machines (ATM) and points-of-sale (POS) for nowcasting and forecasting quarterly private consumption. We take advantage of the availability of such high frequency data by using mixed data sampling (MIDAS) regressions. A comparison of several MIDAS variants proposed in the literature is conducted, and both single- and multi-variable models are considered, together with different information sets within the quarter. Given the substantial use of ATM/POS technology in Portugal, it is important to assess the information content of this data for tracking private consumption. We find that ATM/POS data display a better forecast performance than typical indicators, which reinforces the potential usefulness of this novel type of data among policymakers and practitioners.

1. Introduction

The development of national statistical systems and the improvements made by statistical agencies in compiling and disseminating data to meet the needs of both policymakers and the general public have led to the availability of higher frequency indicators for monitoring changes in economic activity. Although key macroeconomic aggregates, such as GDP, are typically only available at a quarterly frequency, we currently have a relatively wide range of monthly indicators, covering a broad set of economic dimensions. The availability of data at a daily frequency has generally been limited to financial variables, such as stock prices and interest rates.

At the same time, a growing body of literature has focused on the use of higher frequency variables for nowcasting and forecasting the main quarterly macroeconomic variables. The mixed data sampling (MIDAS) regression models introduced by Ghysels, Santa-Clara, and Valkanov (2004) have received considerable attention in the literature. The work of, *inter alia*, Ghysels et al. (2004); Ghysels, Santa-Clara, and Valkanov (2005, 2006), and the growing empirical evidence of its usefulness, have led to a gain in the popularity of MIDAS for forecasting. There is a significant body of literature on the advantages of using MIDAS regressions to improve quarterly macroeconomic forecasts based on monthly and daily data. For instance, Clements and Galvão (2008); Clements and Galvão (2009), Kuzin, Marcellino, and Schumacher (2011), Marcellino and Schumacher (2010), and Schumacher and Breitung (2008) provide evidence of improvements in quarterly forecasts from

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using monthly data, and Andreou, Ghysels, and Kourtellos (2013), Ghysels and Wright (2009) and Monteforte and Moretti (2013), among others, show forecast improvements from the use of daily data. However, given the limited availability of high frequency economic data, MIDAS forecasting has generally been restricted to daily financial series.

Technological progress has encouraged the development and widespread use of electronic payment systems, providing possible new data sources for the monitoring of economic activity, especially data collected from automated teller machines (ATM) and points-of-sale (POS). Typically, electronically recorded data are very timely and free of measurement errors. Such data encompass cash withdrawals at ATM terminals and debit card payments that allow consumers to pay for their purchases by having funds transferred immediately from the cardholder's bank account. Studies relating to this type of data are limited. For instance, Galbraith and Tkacz (2013a) examine daily debit card data in Canada in order to assess the impacts of specific events like the September 11 terrorist attacks; Galbraith and Tkacz (2007) show that debit card payments data can help to lower Consensus forecast errors of GDP and private consumption growth in Canada; and Galbraith and Tkacz (2013b) find that monthly electronic payments data can improve Canadian GDP nowcasting. For Denmark, Carlsen and Storgaard (2010) find that monthly electronic payments by card (Dankort) provide a useful indicator for nowcasting retail sales; and Esteves (2009), using quarterly ATM/POS data for Portugal, presents supporting evidence of the usefulness of such data for nowcasting quarterly private consumption.

The aim of this paper is to forecast private consumption using high-frequency, electronically recorded data from ATM and POS terminals. As such data are available at a higher frequency than quarterly private consumption, we adopt a MIDAS regression approach, considering both monthly and daily ATM/POS data. To the best of our knowledge, this is the first paper to use the MIDAS approach to forecast using non-financial daily data. This reflects the fact that it is unusual to have non-financial data available at such a high frequency. Furthermore, the previous literature on payments data has not used the MIDAS regression framework for forecasting purposes. In this respect, we consider several variants of MIDAS regressions, including the traditional MIDAS setting of Ghysels et al. (2004), the multiplicative MIDAS discussed by Chen and Ghysels (2011), the unrestricted MIDAS advocated by Foroni and Marcellino (2014), Foroni, Marcellino, and Schumacher (2015) and Marcellino and Schumacher (2010), the common factor MIDAS of Clements and Galvão (2008), and the unrestrictedly augmented (with an autoregressive component) MIDAS regressions, known as ADL-MIDAS, representations discussed by Andreou et al. (2013) and Duarte (2014).

This paper focuses on the Portuguese case because ATM/POS technology has a high dissemination rate in Portugal. Thus, information is compiled by a single entity, which allows us to obtain timely data for the purpose of real-time economic assessments and policy-making. Also, the Portuguese economy has experienced considerable turbulence in recent years, with the Great Recession and the subsequent European sovereign debt crisis, leading to a profound macroeconomic adjustment process. This period constitutes a challenging time for forecasting purposes.

In addition to ATM/POS data, several other predictors are also considered for forecasting quarterly private consumption, such as monthly retail sales and consumer confidence. These indicators are among the most commonly used, and allow us to put into perspective the added value of considering the ATM/POS data for forecasting purposes. For the sake of completeness, we also determine whether there is evidence of ATM/POS data playing such an informative role when using other popular models in the literature, such as bridge equations or factor models. Regarding bridge equations (see for example Schumacher, 2016, and references therein), we consider single predictor models. In the case of factor models, we follow the work of Dias, Pinheiro, and Rua (2015) and use the approach developed by Stock and Watson (2002a,b) on a large dataset for the Portuguese economy with and without ATM/POS series.

Overall, we find that the use of high frequency data improves the forecasting performance, with ATM/POS data offering the largest gains. We also find that augmenting MIDAS regressions with an autoregressive component improves the forecast results, while the unrestricted MIDAS framework delivers the best results.

The paper is organized as follows. Section 2 discusses why Portugal is a natural case study for assessing the information content of ATM/POS data. Section 3 briefly describes the MIDAS regression approaches that will be considered in the empirical application, while Section 4 presents the data. Section 5 discusses the forecasting exercise conducted and the corresponding empirical results. Finally, Section 6 provides conclusions.

2. Why is the Portuguese case special?

The Portuguese ATM and POS network (also known as the *Multibanco* network) dates back to 2 September, 1985, when the first ATM terminals were introduced in the main Portuguese cities of Lisbon and Oporto. Initially, only a limited set of operations were possible, including cash withdrawals and the checking of account balances. Thus, customers had access to banking services that previously had been available only at bank branches. This allowed customers to save time and banks to reduce costs (see also Humphrey, Willesson, Bergendahl, & Lindblom, 2006). Over time, the range of services available at ATM terminals increased considerably. Nowadays, ATM terminals can be used to pay for services, top-up mobile phones, pay for transports and tolls, transfer money to other accounts, etc. The Portuguese network is one of the leading cases worldwide in terms of both innovation and functionality. The growing availability of POS and ATM terminals across the country facilitates consumers' day to day lives and allows firms to benefit from a secure and efficient payment system, with natural positive spillovers for businesses.

The *Multibanco* network is run by a single entity, the SIBS Forward Payment Solutions, which simplifies the compilation of data and ensures that data are readily available and up to date. Cardholders can use